TWO-PIECE ROTARY METAL-CUTTING TOOL AND METHOD FOR INTERCONNECTING THE PIECES

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BACKGROUND OF THE INVENTION

The present invention relates to a tool for rotary, cutting machining, comprising a tool body and a cutting portion. The tool body has a front surface, and the cutting portion has a support surface provided to releasably abut against the front surface in a substantially radial plane. The tool body and the cutting portion comprises means which cooperate for holding them together. The invention also relates to a cutting portion and a tool body as well as a method for mounting a cutting portion to a tool body.

PRIOR ART

It is previously known to use interchangeable cutting edges on different types of tools for cutting machining, especially when cutting a metallic workpiece. This technique however has practical limitations due to handling reasons when it comes to milling and drilling tools which rotate around a longitudinal axis.

Through DE-PS-367,010 and Burger U.S. Pat. No. 2,259,611, it is previously known to provide drills with lockable drill tips, wherein the drill tip is retained with the aid of dove-tail profiles or with press fit, respectively. The known tools however are impaired with drawbacks such as bad torsion transferring ability and troublesome mounting and dismounting.

The present invention has as one object to provide drilling and milling tools with interchangeable cutting edges, which eliminates problems associated with known techniques.

Another object with the present invention is provide a rigid tool preferably for drilling or milling wherein the cutting portion cooperates with the tool body via a bayonet coupling.

Another object of the present invention is to provide a rigid tool preferably for drilling or milling wherein the cutting portion can be easily exchanged by hand without time consuming screwing or soldering.

Another object of the present invention is to provide a tool with a self centering cutting portion.

SUMMARY OF THE INVENTION

These and other objects have been achieved by the present invention which relates to a rotary metal-cutting tool comprising, in combination, a tool body and a cutting portion attached to the tool body. The tool body includes a shank portion defining a longitudinal center axis, a front surface, and rear chip flutes formed in an external side surface of the shank portion for guiding chips rearwardly during a cutting operation. The cutting portion includes a rear support surface abutting the front surface, a front cutting face, and front chip flutes formed in a side surface of the cutting portion and intersecting the cutting face to form cutting edges therewith. The tool body and cutting portion are interconnected by a bayonet coupling formed by projections disposed on one of the tool body and cutting portion, and recesses formed in the other of the tool body and cutting portion. The projections are circumferentially offset with respect to the flutes and extend generally longitudinally. The recesses extend circumferentially from

respective flutes. The flutes are sized to longitudinally receive respective projections during longitudinal insertion or removal of the cutting portion relative to the tool body. The cutting portion is rotatable about the center axis relative to the tool body to transfer the projections from the respective flutes and into the recesses while bringing the front flutes into alignment with the rear flutes.

The invention also relates to a method of mounting a cutting portion to a tool body to form a metal-cutting rotary tool. The tool body includes a shank portion, a front surface, and rear chip flutes formed in an outer surface of the tool body. The cutting portion includes a support surface abutting the front surface, a cutting surface having cutting edges, and front chip flutes formed in an outer surface of the cutting portion. One of the tool body and cutting portion includes longitudinal projections, and the other of the tool body and the cutting portion includes circumferential recesses. Each recess communicates with a respective flute and extends less than 180°. The method comprises the steps of:

A) converging the cutting portion and tool body longitudinally toward one another to bring the projections into respective ones of the flutes that communicate with the circumferential recesses; and

B) effecting relative rotation between the tool body and cutting portion to cause the projections to enter respective ones of the recesses to bring the front flutes into alignment with the rear flutes and to bring a stop surface of each projection into longitudinally opposing relationship with a stop surface of a respective recess for defining a bayonet connection preventing longitudinal displacement of the cutting portion relative to the tool body.

DESCRIPTION OF THE DRAWINGS

The objects and advantages of the invention will become apparent from the following detailed description of a preferred embodiment thereof in connection with the accompanying drawing in which like numerals designate like elements, and in which:

FIG. **1** shows a drilling tool according to the present invention, in an exploded perspective view;

FIG. **2** shows a cutting portion according to the present invention in a bottom view;

FIG. **3** shows the cutting portion in a sectional view taken along the line III—III in FIG. **2**;

FIG. **3A** shows the cutting portion in a perspective view from below;

FIG. **4** shows the forward end surface of a tool body according to the present invention in top view;

FIG. **5** shows the drill shank in a sectional view taken along the line V—V in FIG. **4**;

FIGS. **6**, **7** and **8** show cross-sections of a bayonet coupling of the tool;

FIG. **9** shows the assembled tool according to FIG. **1** in a magnified side view.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

The embodiment of a tool **10** according to the invention shown in FIG. **1** is a so called helix drill, which comprises a cutting portion or drill tip **11** and a drill body **12**. The drill has a rotational direction R.

The drill tip **11** is provided with at least one cutting edge **19** in the forward end thereof facing away from the drill body **12**, which tip is given different designs depending on the area of application.

The drill tip **11** is made of hard material, preferably cemented carbide and most preferably of injection molded cemented carbide, and comprises a front cutting surface formed by two upper clearance faces **15**, a lower support surface **16** as well as first and second curved surfaces **41, 18** interconnecting the surfaces **15** and **16**. All these surfaces and associated edges are integrated as one piece with the drill tip and consequently formed of the same material, i.e. preferably injection molded cemented carbide. The curved surfaces **18** form front chip flutes for conducting cuttings rearwardly. Lines of intersection between the chip flutes **18** and the clearance faces **15** form main cutting edges **19**, preferably via reinforcing chambers, not shown. Lines of intersection between the first curved surfaces **41** and the chip flutes **18** form secondary cutting edges **19'**. The chip flute is shown as helical but may alternatively be adapted for a drill body requiring straight chip flutes. The radially external parts between the chip flutes consist of protruding lands formed by the surfaces **41**, each having a circumferential length G (FIG. 4). The largest diameter of the drill tip is the diametrical distance between the radially extreme points of the secondary cutting edges. The height of the drill tip is substantially the same as the largest diameter of the tip, in order to minimize the wear from chips on the joint between the drill tip and the drill body. Flushing holes **23**, extending substantially parallel with the rotational axis **22**, extend through the drill tip from the support surface **16** to the orifice in respective upper clearance surface **15**.

The support surface **16** according to FIGS. **2, 3** and **3A** is substantially planar but comprises a recess **50** at the transition between the support surface **16** and the land **41**. Each recess **50** comprises a first free or end surface **51** perpendicularly connected to both the land **41** and a second free surface **52** (see FIG. **8**), which surface **52** in turn forms an acute angle a with a first guiding surface **53** (see FIG. **6**). The surface **53** connects to a second guiding surface **54** oriented parallel to the rotational axis **22**, and which connects to the support surface **16** via a radius or an entering bevel **55**. The surface **53** is inclined obliquely relative to the center axis **22** so as to face generally radially inwardly and longitudinally rearwardly. As illustrated in FIG. **3**, support surface **16**, recesses **50**, and land **41** define a generally dovetail-shaped projection. The recess **50** has a stop surface **56** (FIG. 3A) which is parallel to the axis **22** and which suitably lies in an axial plane which intersects said axis. The recess **50** extends in a tangential direction from the chip flute **18** to about a midpoint of the circumferential length G of the associated land **41**.

The drill body is made of a material which has a lower Young's modulus than cemented carbide. The drill body has helical rear chip flutes **18A** (or straight chip flutes if required) and these can extend along the entire outer surface of a shank portion **40** of the body or along only a part thereof. The drill body **12** is provided with a front surface **24** at the end facing towards the drill tip **11**, which surface **24** abuts against the support surface **16** of the drill tip **11**. The largest diameter of the support surface **16** is larger than the largest diameter of the front surface **24** in order to minimize the wear from chips on the joint between the drill tip and the drill body. The drill body also includes curved surfaces **41A** forming lands. The front surface **24** is substantially planar but comprises a projection **60** at the transition between the front surface **24** and the jacket surface of each land **41A**. The height of the projection is somewhat less than that of the depth of the recess **50**.

Each projection **60** comprises a first free or end surface **61** perpendicularly connected to the jacket surface **41A**, said

surface **61** also perpendicularly connected to a second free surface **62**, which in its turn forms an acute angle π with a first guiding surface **63**. The surface **63** connects to a second guiding surface **64** oriented parallel to the rotational axis **22**. The surface **64** connects to the front surface **24** via a radius **65**. The surface **63** is oriented parallel to the surface **53** so as to face generally radially outwardly and longitudinally forwardly. As illustrated in FIG. **5**, the above-described surfaces, along with front surface **24**, form a centrally disposed generally dovetail-shaped recess. The projection **60** has a stop surface **66**, FIG. **9**, which is parallel with the axis **22** and which suitably lies in an axial plane which contains said axis.

The smallest diameter of the front surface **24** is smaller than the largest diameter of the drill tip but larger than the smallest diameter of the drill tip. The projection **60** extends in a tangential direction from the chip flute **18**A to about the midpoint of the circumferential tangential length G' of the associated land **41**A.

The stop surfaces **56** and **66**, respectively, should be as far from the rotational axis as possible for best moment transfer, i.e. they are arranged diametrically opposed each other. The drill tip must be symmetrically formed in order to retain the tool's concentricity at varying strain, i.e. in order to keep the drill tip centered relative to the drill body. The projections **60** and the recesses **50** lie at a distance from and substantially rearwardly of the associated cutting edge **19** in the tool's rotational direction R.

Mounting of the drill tip **11** on the drill body **12** is done as follows. The drill tip **11** is brought in the axial direction towards the drill body **12**, so that each projection **60** is received in the associated chip flute **18** and so that the support surface **16** abuts against the front surface **24** thereby bringing the generally dove-tail shaped projection of the drill tip **11** into mating engagement with the generally dovetail-shaped recess of drill body **12**. Then, the drill tip is rotated in the direction R within an angle interval ϕ which is less than 360°, preferably less than 60°, relative to the drill body so that each projection **60** moves with a slide fit in the respective recess **50** until the stop surfaces **56** and **66** abut against each other. The drill tip **11** is now anchored in the drill body **12** in a satisfactory manner. Thus, the preformed spaces defined by the chip flutes **18** are used as the entrance and the exit of the bayonet coupling.

When the drill tip **11** must be replaced, the mounting procedure is reversed. The drill tip **11** then can be removed from the drill body **12** and be exchanged, preferably with the aid of a suitable key in engagement with the chip flutes on the drill tip. The key is preferably also used during mounting of the drill tip.

The surfaces which during the drilling operation must be in engagement are surfaces **53** and **63** as well as the support surface **16** and the front surface **24**. The surfaces **53** and **63** cooperate to hold the drill tip such that it cannot loosen in the feed direction, for example during retraction of the tool. The surfaces **53** and **63** are preferably designed such that their cooperation results in some elastic deflection of the projection **60** due to the slide fit. A limited contact surface between surfaces **54** and **64** can be allowed, but this implies an increased moment at the radius **65**. The drill tip is self-centering in the tool body, i.e. it moves such that its axis coincides with the rotational axis **22** if it has been displaced during the machining operation. The surface **55** will allow the radius **65** of the tool body to be relatively large. The surfaces **52** and **62** should not be in engagement with each other during the machining operation. That is realized by